DOE Pulse
Science and Technology Highlights from the DOE National Laboratories

Number 205 | March 20, 2006

Sandia's Chris Shaddix, left, and Alejandro Molina.

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Research Highlights . . .

Making quick work of detecting effects of nanoparticles

Scientists at DOE's Pacific Northwest National Laboratory have harnessed living cells to monitor responses to a variety of toxins in an investigation of possible damage from sub-micron sized particles. The process enlists Fourier transform infrared (FTIR) spectroscopy and requires that live cells be grown on an infrared transparent substrate, allowing close examination of biological effects in the cells. It may be the first time FTIR spectroscopy has been used to examine the biological response of living cells to nanoparticles. Using this process, FTIR spectra are captured in minutes, offering up a "biomarker"—a tool for quick discovery of biologically active nanoparticles.

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Research shows ventilated auto seats improve fuel economy, comfort

DOE's National Renewable Energy Laboratory has demonstrated that ventilated automotive seats not only can improve passenger comfort but also a vehicle's fuel economy. Ventilated seats keep drivers and passengers cooler so less air conditioning is needed to be comfortable. W.E.T. Automotive Systems Ltd. provided NREL with ComfortCools seats for testing and by using its suite of thermal comfort tools and subjective test data, NREL measured improvement in human thermal sensation for the ventilated seats and the potential for a 7 percent reduction in air-conditioning compressor power. NREL developed its thermal comfort tools to help the automotive industry design smaller and more efficient climate-control systems in vehicles.

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Reducing carbon composite costs key for carmakers

Researchers at DOE's Oak Ridge National Laboratory, are working with Ford, General Motors and DaimlerChrysler to lower the cost of carbon fiber composites. If they are successful in developing high-volume renewable sources of carbon fiber feedstocks, highways of tomorrow might be filled with lighter, cleaner and more fuel-efficient automobiles made in part from recycled plastics, lignin from wood pulp and cellulose. Carbon fiber is one-fifth the weight of steel yet just as strong and stiff, which makes it ideal for structural or semi-structural components in automobiles. All of this would come with no sacrifice in safety, as preliminary results of computer crash simulations show that cars made from carbon fiber would be just as safe—perhaps even safer—than today's automobiles.

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NETL researchers test new coal shrinkage-swelling model

Coal swelling can occur from sorption of CO_2 when it is injected into an unmineable seam for geologic sequestration and enhanced production of coalbed methane. Researchers at DOE's National Energy Technology Laboratory have developed and tested a three-dimensional swelling and shrinkage model to account for the effects of CO_2 and methane on coal. Researchers modified a previously validated dual-porosity reservoir simulator to incorporate the shrinkage-swelling model. The simulator has been used to interpret field data, and the results show that coal swelling caused by CO_2 absorption can significantly reduce the amount of injectable CO_2.

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DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. ***DOE Pulse*** (www.ornl.gov/news/pulse/) is distributed every two weeks. For more information, please contact Jeff Sherwood (jeff.sherwood@hq.doe.gov, 202-586-5806).

SNS accumulator ring successfully commissioned

DOE's Spallation Neutron Source, located at Oak Ridge National Laboratory, has passed another milestone on the way to completion this year—the commissioning of the proton accumulator ring, which was designed and built at Brookhaven National Laboratory.

Five Office of Science laboratories—Argonne, Berkeley, Brookhaven, Jefferson and Los Alamos—participated with Oak Ridge in the design of the SNS project, which will produce the world's most intense neutron beams to probe the molecular structures of materials. As a user facility, the SNS is expected to attract researchers from all over the globe.

"The ring is the last major accelerator element delivered by one of the partner labs in the six-laboratory project," said SNS Director Thom Mason. "Its successful operation confirms not just the robustness of the Brookhaven Lab components but also the full integration of accelerator hardware designed and built using expertise throughout the national DOE complex. We are looking forward to the first beam on target later this year."

The accumulator ring is the final step in a proton's journey through the accelerator before it strikes the SNS's mercury target, "spalling" away neutrons to be used for research. The Brookhaven-led accumulator ring design will allow an order of magnitude more beam power than any other facility in the world.

In SNS operation, the superconducting linac produces proton pulses traveling at almost 90 percent of the speed of light. In the ring, the protons within a pulse are "accumulated" to increase the intensity 1,000-fold. At that point, this now very intense pulse is extracted and delivered to the mercury target to produce neutrons. This happens 60 times per second.

During its recent commissioning, after only three days of initial operation, the ring accumulated protons, which were then extracted and sent to a point just short of the target.

"The successful commissioning of the accumulator ring—in record time for this type of device—is a testament to the extraordinary collaboration between Brookhaven and Oak Ridge," said Jie Wei, who led the Brookhaven team.

The SNS will become the world's leading research facility for study of the structure and dynamics of materials using neutrons, with many potential future applications in telecommunications, manufacturing, transportation, information technology, biotechnology, and health.

Submitted by DOE's Brookhaven National Laboratory

Clean coal 'bridge' to hydrogen economy

Chris Shaddix, principal investigator for clean coal combustion at the Combustion Research Facility of Sandia National Laboratories' California lab, believes the path to the hydrogen economy leads through the territory familiar to him and the members of his team.

We may some day be able to produce hydrogen by breaking up water molecules in association with the high-temperature heat from nuclear power reactors, or through renewable energy technologies, but right now the most cost-effective way to produce hydrogen is with coal, he says.

Chris Shaddix, left, and Alejandro Molina discuss an experiment to determine the best proportion of oxygen and CO_2 for oxy-combustion of coal.

While traditional coal combustion produces many harmful emissions, modern plants can meet environmental regulations for burning coal cleanly, he says. This can be costly to utility companies, but the cost of competing fuels—particularly natural gas—have climbed to the point where burning clean coal is competitive. Figure in the possible benefits of sequestration of carbon dioxide emissions from the stacks and coal looks very promising for generating both electricity and hydrogen to provide a bridge to that future technology. "Utilities are starting to invest in coal," he says.

Two different approaches to burning coal are now under study. One, called oxy-combustion, combines coal with pure oxygen as a near-term solution that with current knowledge can produce exhaust streams that are close to pure CO_2 and virtually eliminate harmful pollutants like nitrogen oxides, sulfur compounds, and mercury.

The second, called gasification, burns coal only partially to create a fuel-gas, which can be burned to produce power, or further reacted to shift the remaining CO to CO_2 and to produce more hydrogen. The CO_2 can be sequestered and the hydrogen can be used to power a land vehicle or aircraft, or a turbine to produce electricity.

DOE has demonstrated this process in two pilot projects.

Submitted by DOE's Sandia National Laboratories